Complete Summary

GUIDELINE TITLE

Guidelines for the field management of combat-related head trauma. Treatment: brain-targeted therapy.

BIBLIOGRAPHIC SOURCE(S)

Knuth T, Letarte PB, Ling G, Moores LE, Rhee P, Tauber D, Trask A. Guidelines for the field management of combat-related head trauma. Treatment: brain-targeted therapy. New York (NY): Brain Trauma Foundation; 2005. 13 p. [58 references]

GUIDELINE STATUS

This is the current release of the guideline.

COMPLETE SUMMARY CONTENT

SCOPE

DISEASE/CONDITION(S)

Combat-related traumatic brain injury

GUIDELINE CATEGORY

Evaluation
Management
Treatment

CLINICAL SPECIALTY

Emergency Medicine
Neurological Surgery
Neurology

INTENDED USERS

Emergency Medical Technicians/Paramedics
Physicians

GUIDELINE OBJECTIVE(S)

- To provide dispassionate analysis of the known benefits and risks of therapies available to the brain injured patient in the field
- To be a resource and a tool for the combat medic, physician, commanding officer, and logistician who must then make the tough "on the ground" therapeutic, tactical, and logistical decisions that will ultimately result in optimum care for the injured combatant
- To review available therapies for traumatic brain injury in remote environments that provide the potential for some brain resuscitation, i.e., hyperventilation, hyperosmolar therapy, analgesics, sedatives, lidocaine, paralysis, and control of hyperglycemia

TARGET POPULATION

Combat personnel who sustain traumatic brain injury in the field

INTERVENTIONS AND PRACTICES CONSIDERED

1. Hyperosmotic agents (hyperosmolar urea, mannitol, hypertonic saline)
2. Hyperventilation only for patients with signs of cerebral herniation
3. Antibiotic prophylaxis
4. Sedatives and analgesics
5. Finger-stick serum glucose monitoring and control of serum glucose levels

MAJOR OUTCOMES CONSIDERED

- Time to and duration of treatment effect
- Glasgow Coma Score
- Changes in intracranial pressure and cerebral perfusion pressure
- Changes in blood pressure and laboratory parameters
- Incidence of postoperative brain infections
- Morbidity and mortality

METHODOLOGY

METHODS USED TO COLLECT/SELECT EVIDENCE

Hand-searches of Published Literature (Primary Sources)
Hand-searches of Published Literature (Secondary Sources)
Searches of Electronic Databases

DESCRIPTION OF METHODS USED TO COLLECT/SELECT THE EVIDENCE

General Search Strategy

In order to create an evidence-based document relevant to the field treatment of brain injury, the literature was searched for each topic for publications on brain injury that pertained to the prehospital or austere environment. From the comprehensive literature searches, articles were selected which were relevant to the field management of traumatic brain injury (TBI) and utilized human data. Articles with outcomes related to morbidity and mortality were preferred. In establishing a literature base for recommendations, the guideline authors generally only include publications that involve human subjects. However, in these Guidelines, they have included some publications that involve training with mannequins given that such training is an accepted practice in assessing competency for emergency medical technician (EMT) certification. Additional studies were, in general, referenced only as a part of background discussion. The prehospital literature was heavily utilized; military literature was used where it was available.

Specific Strategy for This Topic

A MEDLINE search was conducted from 1966 to 2005 using the keywords "hyperglycemia," "hyperventilation," "glucose," "mannitol," "urea," "lidocaine," "conscious sedation," "analgesics," "hypnotics," and "sedatives," "neuromuscular blocking agents," "neuromuscular blockade," and "neuromuscular junction," in combination with "emergency medical services," "air ambulance," "emergency medical technician," "intracranial trauma," "military medicine," "recreation," "critical care," "prehospital," and "wilderness medicine." From this group, articles relevant to the field management of TBI with human data and generally more than 25 subjects with outcome related to mortality were selected. Fourteen articles met these criteria. Additional articles and animal studies are referenced only as a part of background discussion.

NUMBER OF SOURCE DOCUMENTS

14

METHODS USED TO ASSESS THE QUALITY AND STRENGTH OF THE EVIDENCE

Weighting According to a Rating Scheme (Scheme Given)

RATING SCHEME FOR THE STRENGTH OF THE EVIDENCE

Classification of Evidence

Class I: Evidence from good quality, randomized, controlled clinical trials (RCT)

Class II: Evidence from moderate or poor quality RCT, good quality cohort, or good quality case-control studies

Class III: Evidence from moderate or poor quality cohort; moderate or poor quality case control; or case series, databases, or registries

Additional detail on quality criteria for each category is available in the original guideline document.

METHODS USED TO ANALYZE THE EVIDENCE

Systematic Review with Evidence Tables

DESCRIPTION OF THE METHODS USED TO ANALYZE THE EVIDENCE

The Guidelines follow the recommendations of the Institute of Medicine (IOM) Committee to Advise the Public Health Service on Clinical Practice Guidelines outlined below:

1. There should be a link between the available evidence and the recommendations.
2. Empirical evidence should take precedence over expert judgment in the development of guidelines.
3. The available scientific literature should be searched using appropriate and comprehensive search terminology.
4. A thorough review of the scientific literature should precede guideline development.
5. The evidence should be evaluated and weighted, depending on the scientific validity of the methodology used to generate the evidence.
6. The strength of the evidence should be reflected in the strength of the recommendations, reflecting scientific certainty (or lack thereof).
7. Expert judgment should be used to evaluate the quality of the literature and to formulate guidelines when the evidence is weak or nonexistent.
8. Guideline development should be a multidisciplinary process, involving key groups affected by the recommendations.

METHODS USED TO FORMULATE THE RECOMMENDATIONS

Expert Consensus

DESCRIPTION OF METHODS USED TO FORMULATE THE RECOMMENDATIONS

The authors of these guidelines, entitled *Guidelines for the Field Management of Combat-Related Head Trauma*, represented a multidisciplinary group consisting of neurosurgeons, trauma surgeons, neurointensivists, and paramedics from both the civilian and the military sectors. They were selected for their expertise in traumatic brain injury (TBI), combat medicine, or military medical education. All the military authors had recent combat experience. Each author independently conducted a MEDLINE or comparable search, reviewed and evaluated the literature for their assigned topics, then cooperated in formulating the Guidelines during several work sessions aimed at completing understandable and applicable recommendations based on the best evidence available. The template for these Guidelines was the first edition of the *Guidelines for Prehospital Management of*

Traumatic Brain Injury developed by Brain Trauma Foundation (BTF) in 1999–2000.

Section I of each chapter in the original guideline document describes the conclusions the authors formulated from the literature. For the chapters on assessment, which included prognosis studies, the authors summarized the evidence rather than made recommendations. Thus, their findings are listed as "Conclusions" for any diagnostic or prognostic assessment and as "Recommendations" where the end result is a specific treatment or set of treatment options. Section VII in each chapter provides a brief analysis of the literature that supports the conclusions or recommendations, whereas Section VIII references a more extensive list of studies.

RATING SCHEME FOR THE STRENGTH OF THE RECOMMENDATIONS

Degrees of Certainty

Standards: Reflect a *high degree of clinical certainty* as indicated by the scientific evidence available (supported by Class I evidence).

Guidelines: Reflect a *moderate degree of clinical certainty* as indicated by the scientific evidence available (supported by Class II evidence).

Options: Reflect *unclear clinical certainty* as indicated by the scientific evidence available (supported by Class III evidence).

COST ANALYSIS

A formal cost analysis was not performed and published cost analyses were not reviewed.

METHOD OF GUIDELINE VALIDATION

External Peer Review
Internal Peer Review

DESCRIPTION OF METHOD OF GUIDELINE VALIDATION

At several points during the development process, a review team comprised of representatives of the armed services medical "school houses," military neurosurgery and trauma surgery, and military medic instruction evaluated the document, and their comments were delivered to the authors. Several draft documents were produced and evaluated before this document was finalized and published. (The names of the reviewers are listed at the front of the original guideline document.)

RECOMMENDATIONS

MAJOR RECOMMENDATIONS

"Degrees of Certainty" (Standards, Guideline, Options) and "Classification of Evidence" (Class I to III) and the correlation between the two are defined at the end of the "Major Recommendations" field.

Recommendations

A. **Standards**

Insufficient data to support a treatment standard for any brain-targeted therapy for patients with severe head injury.

B. **Guidelines**

Data supports the use of mannitol in response to herniation at doses of 1.4–2.1 g/kg if supported by the capacity to provide high fluid volume compensation for any ensuing urine loss.

C. **Options**

Hypertonic Saline

Hypertonic saline appears to reduce intracranial pressure (ICP) when given as a bolus and may be given for this purpose although an improvement in neurological outcome with resuscitation with hypertonic saline over standard fluid resuscitation has not been demonstrated.

Hyperventilation

Hyperventilation is to be avoided both as an intended therapy and inadvertently as part of other airway management, except in the context of visible signs of cerebral herniation, when its use may delay herniation.

Antibiotic Prophylaxis for Penetrating Brain Injury

Use of prophylactic broad-spectrum antibiotics is recommended for patients with penetrating brain injury.

Treatments to Optimize Patient Transport

While sedation and analgesia will be given for many reasons to the brain-injured patient, no literature supports a specific brain-targeted or protective effect from these medications.

Treating Other Causes of Altered Mental Status

Hypoglycemia can result in altered mental status and coma. Exact correlation between symptoms and serum glucose levels does not exist. Finger-stick serum glucose should be obtained as soon as possible in the patients care and any hypoglycemia corrected.

Summary

The brain-targeted therapies possible away from a treatment facility in a prehospital or remote environment are hyperventilation, hyperosmolar therapy, sedation, and control of glucose. Hyperventilation will delay herniation but can also impact outcomes by creating ischemia, limiting its use to patients who show clinical evidence of herniation. Hyperosmolar therapy has been shown to improve outcome. Unfortunately, the hyperosmolar agent demonstrated to provide benefit, mannitol, is a high volume agent. The lower volume agent, hypertonic saline, has shown neither benefit nor detriment over isotonic solutions. While analgesics, sedatives and lidocaine will continue to be part of the early care of brain-injured patients, no evidence exists for a specific beneficial brain effect. Prevention of hypoglycemia should continue to be a priority. The impact on neurological outcome of limiting hyperglycemia is still to be determined. Although obtaining tight control of serum glucose in the prehospital environment may not be practical in all cases, checking and managing serum glucose as soon as practical in the patient's course is advisable.

Definitions:

Classes of Evidence

Class I: Evidence from good quality randomized controlled trials (RCT)

Class II: Evidence from moderate or poor quality RCT, good quality cohort, or good quality case-control studies

Class III: Evidence from moderate or poor quality cohort; or moderate or poor quality case-control; or case series, databases, or registries

Degrees of Certainty

Standards: Reflect a *high degree of clinical certainty* as indicated by the scientific evidence available (supported by Class I evidence).

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Options: Reflect *unclear clinical certainty* as indicated by the scientific evidence available (supported by Class III evidence).

CLINICAL ALGORITHM(S)

A clinical algorithm for "Field Management of Combat-Related Head Trauma" is provided in the original guideline document.

EVIDENCE SUPPORTING THE RECOMMENDATIONS

TYPE OF EVIDENCE SUPPORTING THE RECOMMENDATIONS

An evidentiary table appears at the end of each major section of the guideline document, which classifies each citation based on the quality of the evidence (Class I-III; see "Major Recommendations" for definitions). The recommendations in this summary are supported by nine Class III studies and five Class II studies.

BENEFITS/HARMS OF IMPLEMENTING THE GUIDELINE RECOMMENDATIONS

POTENTIAL BENEFITS

Appropriate use of brain-targeted therapy in combat-related brain injury

POTENTIAL HARMS

- Careful monitoring of urine output with aggressive replacement of this fluid loss is also recommended to prevent hypotension associated with the use of mannitol.
- Mannitol and other hyperosmotics are known to be able to briefly open the blood brain barrier. Furthermore, at rates of administration which exceed the rate of excretion of mannitol, mannitol can accumulate in the extracellular space. These factors lead to the accumulation of mannitol in the extracellular space and a reverse osmotic gradient which can lead to a "rebound effect" or movement of water into the brain.

QUALIFYING STATEMENTS

QUALIFYING STATEMENTS

- The information contained in the *Guidelines for the Field Management of Combat-Related Head Trauma*, which reflects the current state of knowledge at the time of completion (November 2005), is intended to provide accurate and authoritative information about the subject matter covered. Because there will be future developments in scientific information and technology, it is anticipated that there will be periodic review and updating of these Guidelines. These Guidelines are distributed with the understanding that the Brain Trauma Foundation is not engaged in rendering professional medical services. If medical advice or assistance is required, the services of a competent physician should be sought. The recommendations contained in these Guidelines may not be appropriate for use in all circumstances. The decision to adopt a particular recommendation contained in these Guidelines must be based on the judgment of medical personnel, who take into consideration the facts and circumstances in each case and on the available resources.
- The majority of available recommendations are extrapolated from civilian data. In some instances, it will be obvious that the best civilian data have direct application to military scenarios. In others, it will be equally obvious that the best available civilian recommendation is impractical at best, and potentially threatening to life or mission accomplishment at worst. The guideline authors have attempted to discriminate between the two as often as possible, based on the available military-specific literature and personal experience. Ultimately, it will be the decision of the individual medic and/or the unit chain of command as to whether a particular diagnostic or

therapeutic maneuver can be implemented. The general direction the authors have taken with their recommendations is that the best-known community standard should be implemented whenever possible.

- The recommendations in these guidelines are based on the best available data, and the authors maintained a patient-driven focus during development. In other words, each recommendation was created based upon the best care possible for the patient, in spite of the fact that tactical limitations may prevent this level of care from actually being available to all patients at all times. It should also be noted that guidelines such as these are quite different than protocols developed by medical facilities or military units. Protocols should be generated locally to give very specific directions as to how individual providers are to act in a variety of situations. Guidelines such as these are intended to serve as a starting point for the development of facility-specific protocols.
- Factors that create limitations in the level of medical care available in the combat environment include the overall tactical scenario, physiologic parameters associated with combat, and logistics. The guideline authors' ability to develop standards for optimal management is limited by a lack of scientific data. The majority of the recommendations provided are extrapolated from civilian data. While many of these recommendations will be both practical and applicable, the ability of the individual medic to provide this care may be limited.

IMPLEMENTATION OF THE GUIDELINE

DESCRIPTION OF IMPLEMENTATION STRATEGY

An implementation strategy was not provided.

IMPLEMENTATION TOOLS

Clinical Algorithm

For information about availability, see the "Availability of Companion Documents" and "Patient Resources" fields below.

INSTITUTE OF MEDICINE (IOM) NATIONAL HEALTHCARE QUALITY REPORT CATEGORIES

IOM CARE NEED

Getting Better

IOM DOMAIN

Effectiveness

IDENTIFYING INFORMATION AND AVAILABILITY

BIBLIOGRAPHIC SOURCE(S)

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ADAPTATION

Not applicable: The guideline was not adapted from another source.

DATE RELEASED

2005

GUIDELINE DEVELOPER(S)

Brain Trauma Foundation - Disease Specific Society

SOURCE(S) OF FUNDING

Brain Trauma Foundation

Uniformed Services University of the Health Sciences

GUIDELINE COMMITTEE

Not stated

COMPOSITION OF GROUP THAT AUTHORED THE GUIDELINE

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FINANCIAL DISCLOSURES/CONFLICTS OF INTEREST

Not stated

GUIDELINE STATUS

This is the current release of the guideline.

GUIDELINE AVAILABILITY

Electronic copies: Available in Portable Document Format (PDF) from the Brain Trauma Foundation Web site.

Print copies: Available from the Brain Trauma Foundation, 708 Third Avenue, New York, NY 10017

AVAILABILITY OF COMPANION DOCUMENTS

None available

PATIENT RESOURCES

None available

NGC STATUS

This NGC summary was completed by ECRI Institute on August 24, 2007. The information was verified by the guideline developer on January 28, 2008.

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